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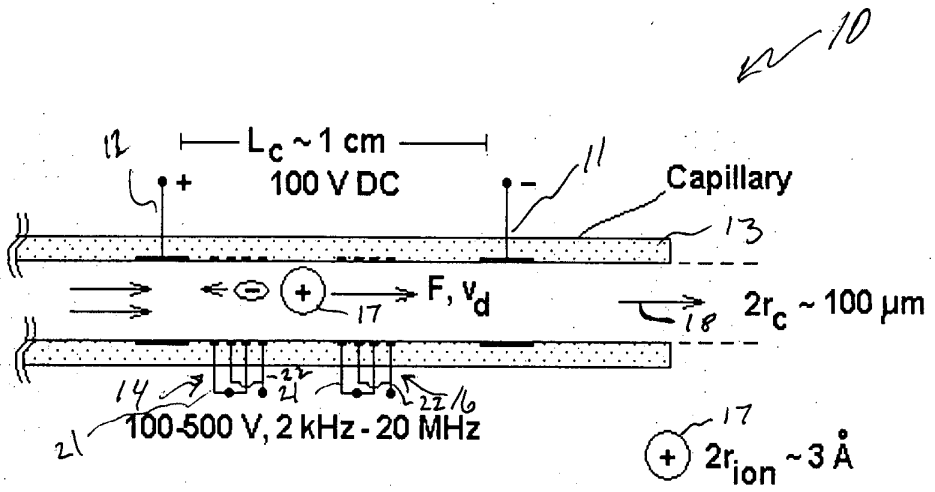

FIGURE 1

1100.124101

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Applied Pot. V	Ion	Gas Velocities for Ls=Le	Ls	Re(Ls)	Δp(Ls)	Qohmic	Ion+Flow Qvisc	Qgen	Qvisc+Qgen Qtotal	Qideal
* 100	mol fraction	cm/s	cm/s	-	psid	mW	mW	mW	mW	mW
	1.000E-12	0.01	0.00	0.000	0.000010	0.0000000	1.238E-12	0.000001	1.11E-06	1.238E-12
Ion Radius, rion cm	3.162E-12	0.04	0.00	0.000	0.000031	0.0000001	1.238E-11	0.000003	3.51E-06	1.238E-11
	1.000E-11	0.12	0.00	0.000	0.000097	0.0000002	1.238E-10	0.000011	1.11E-05	1.238E-10
* 1.50E-08	3.162E-11	0.37	0.01	0.001	0.000307	0.0000005	1.238E-09	0.000035	3.51E-05	1.238E-09
	1.000E-10	1.18	0.02	0.002	0.000971	0.0000017	1.238E-08	0.000109	1.11E-04	1.238E-08
Cap.Radius, rc cm	3.162E-10	3.72	0.07	0.005	0.003072	0.0000053	1.238E-07	0.000346	3.51E-04	1.238E-07
	1.000E-09	11.76	0.24	0.016	0.009715	0.0000168	1.238E-06	0.001095	1.11E-03	1.238E-06
* 0.005	3.162E-09	37.20	0.74	0.050	0.030721	0.0000531	1.238E-05	0.003465	3.53E-03	1.238E-05
	1.000E-08	117.62	2.35	0.159	0.097147	0.0001684	0.00012	0.010996	0.01	0.0001
Field Length, Le cm	3.162E-08	371.96	7.44	0.502	0.307206	0.0005383	0.00124	0.035152	0.04	0.0012
	1.000E-07	1176.23	23.52	1.586	0.971472	0.0017605	0.01238	0.114973	0.13	0.0124
* 1	3.162E-07	3719.57	74.39	5.016	3.072064	0.0061508	0.12379	0.401686	0.53	0.1238
	1.000E-06	11762.30	235.25	15.863	9.714720	* 0.0252860	* 1.23787	1.651345	* 2.91	* 1.2379
Tot.Cap.Length, Ls	3.162E-06	37195.66	743.91	50.163	30.720642	0.1383175	12.37871	9.033049	21.55	12.3787
cm	1.000E-05	117623.02	2352.46	158.628	97.147201	1.0209592	123.78713	66.675372	191.48	123.7871
* 50	Drift Vel. in cm/s, vd =		461.747							
	NA, Avogadro Num. in 1/cm3 =			2.8830E+19						
Eion, Ioniz.Energy eV	q, Electronic Charge in Cb =			1.6022E-19		* 1				
* 70										

FIGURE 2

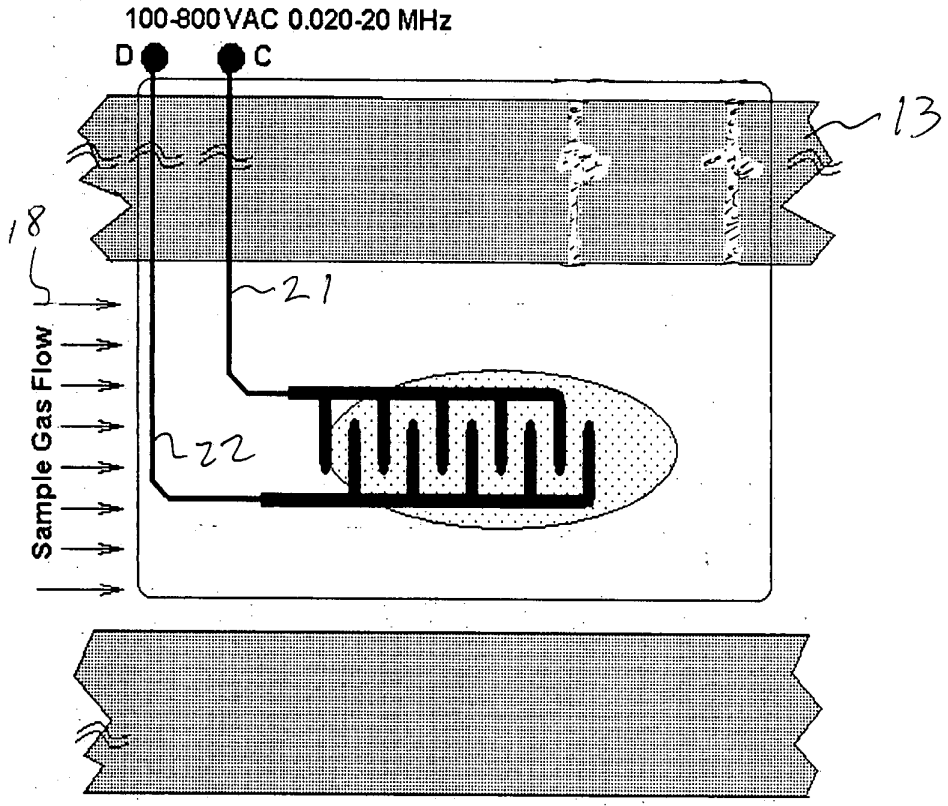

FIGURE 3

Electron Affinities and Electron Configurations

Element	*Electron Affinity (kJ/mol)*	*Electron Configuration*	*Ionization Energies (kJ/mole)*
H	72.8	$1s^1$	1300
He	<0	$1s^2$	2400
Li	59.8	[He] $2s^1$	
Be	<0	[He] $2s^2$	
B	27	[He] $2s^2$ $2p^1$	
C	122.3	[He] $2s^2$ $2p^2$	1050
N	<0	[He] $2s^2$ $2p^3$	
O	141.1	[He] $2s^2$ $2p^4$	1300
F	328.0	[He] $2s^2$ $2p^5$	
Ne	<0	[He] $2s^2$ $2p^6$	

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FIGURE 4

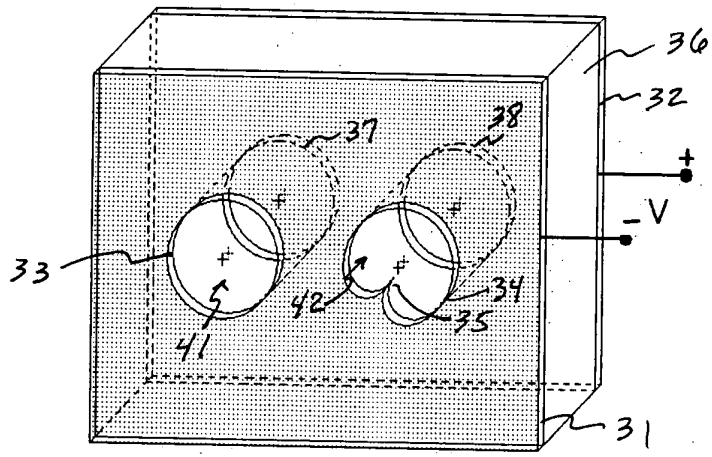

FIGURE 5

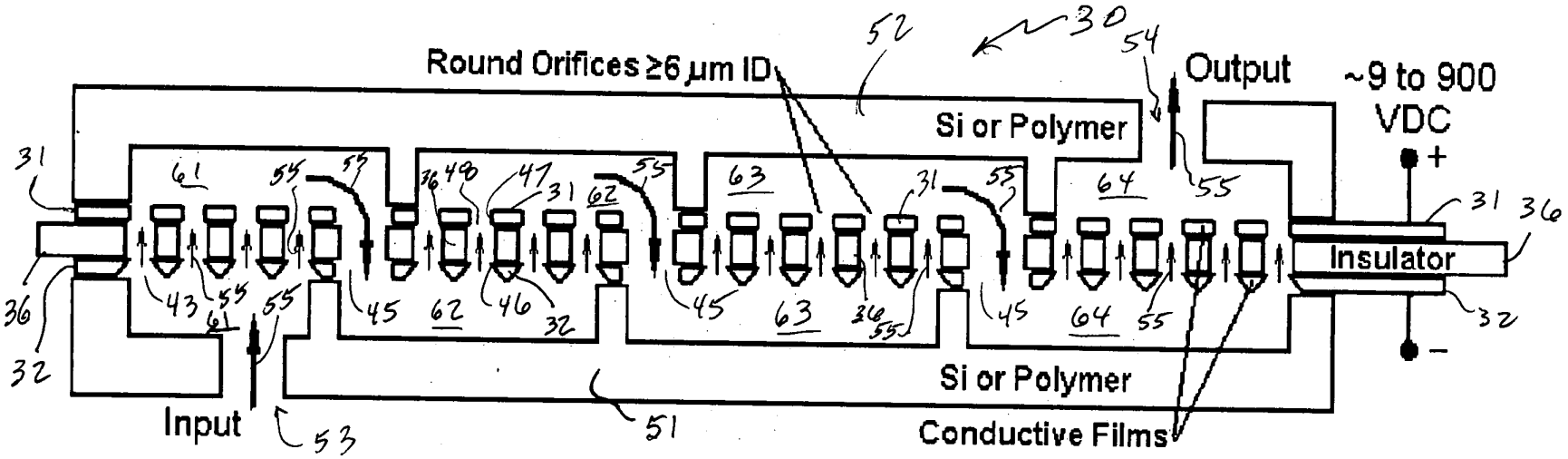
Round Orifices ≥6 µm ID
52
30
54
Output
~9 to 900
VDC
+
Si or Polymer
31
61
55
55
36
49
47
31
62
55
63
31
55
64
55
31
36
Insulator
43
61
55
55
45
62
46
32
45
63
36
55
45
64
55
32
36
32
Si or Polymer
Input
53
51
Conductive Films

FIGURE 6

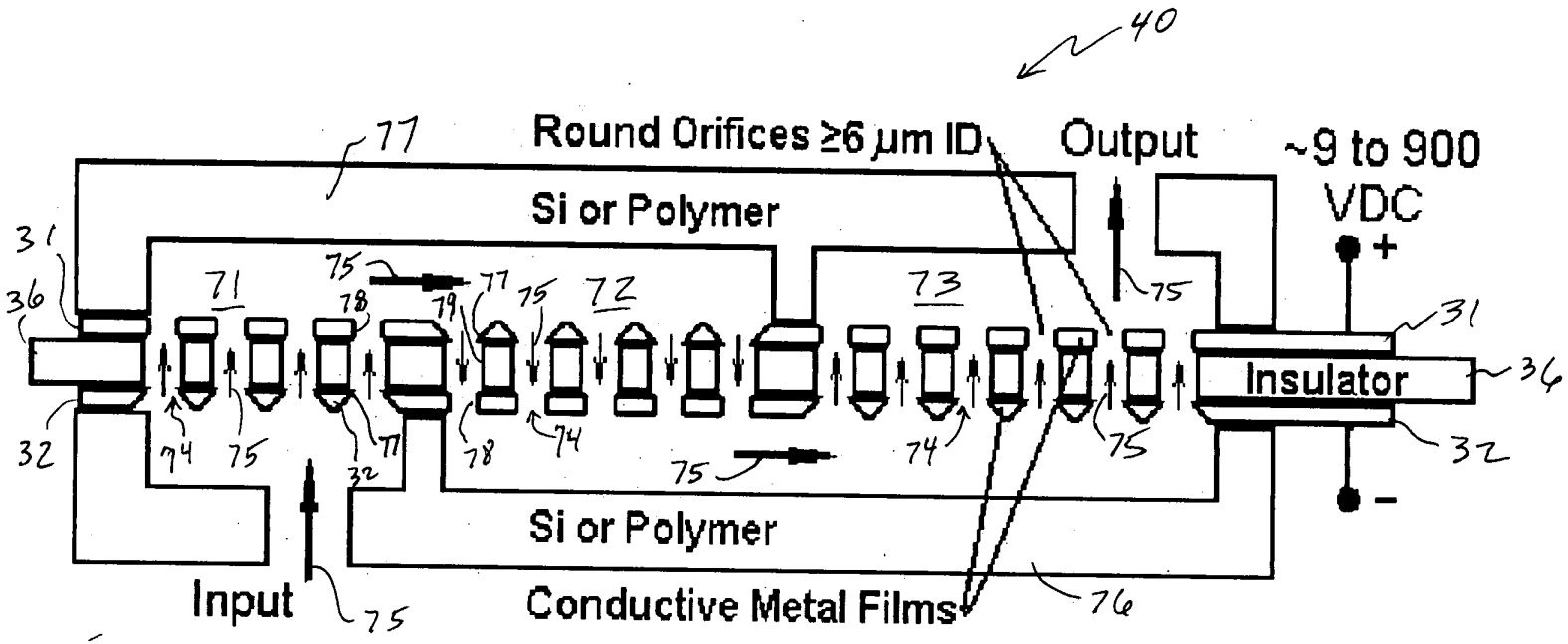
40
77
Round Orifices ≥6 µm ID
Output
~9 to 900
VDC
+
Si or Polymer
31
36
71
72
73
75
78
79
74
Insulator
32
Si or Polymer
Input
Conductive Metal Films
76

FIGURE 7

Comparison of Performance Between Pumps Based on Different Technologies

Method	Base Unit Size x N		Frequency	Power	Voltage	Flow Rate	Δp
-	mm3		Hz	mW	V	cm3/min	psid
Theoretical	-		DC	1.26	1.41	9.7	
Ion Drag	10 x 0.25 x 1	= 2.5	DC	1.65	401.41	9.7	
MesoPump (el.-static, future)	5x5x0.5x**15**	= 188	25	14	100	1.0	10
MesoPump (el.-static, today)	10x10x1x**50**	= 5000	3	25	150	1.0	10
MesoPump (el.-static, today)	10x10x1x**50**	= 5000	3	25	150	1.0	10
Piezo-Electric (Fraunhofer)	7x7x1.1x**7x14**	= 5282	100		98		

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FIGURE 8

Temper. T in K	Temperature Dependence of Ion Concentration Ion Aff. Energy E(-) in J/mol 100,000 exp(-E/RT)	Ionizat.Energy E(+) in J/mol 1,000,000 exp(-E/RT)
600	2.239E-09	3.169E-87
1500	3.468E-04	2.514E-35
2000	2.541E-03	1.123E-26
2500	8.395E-03	1.739E-21

FIGURE 9

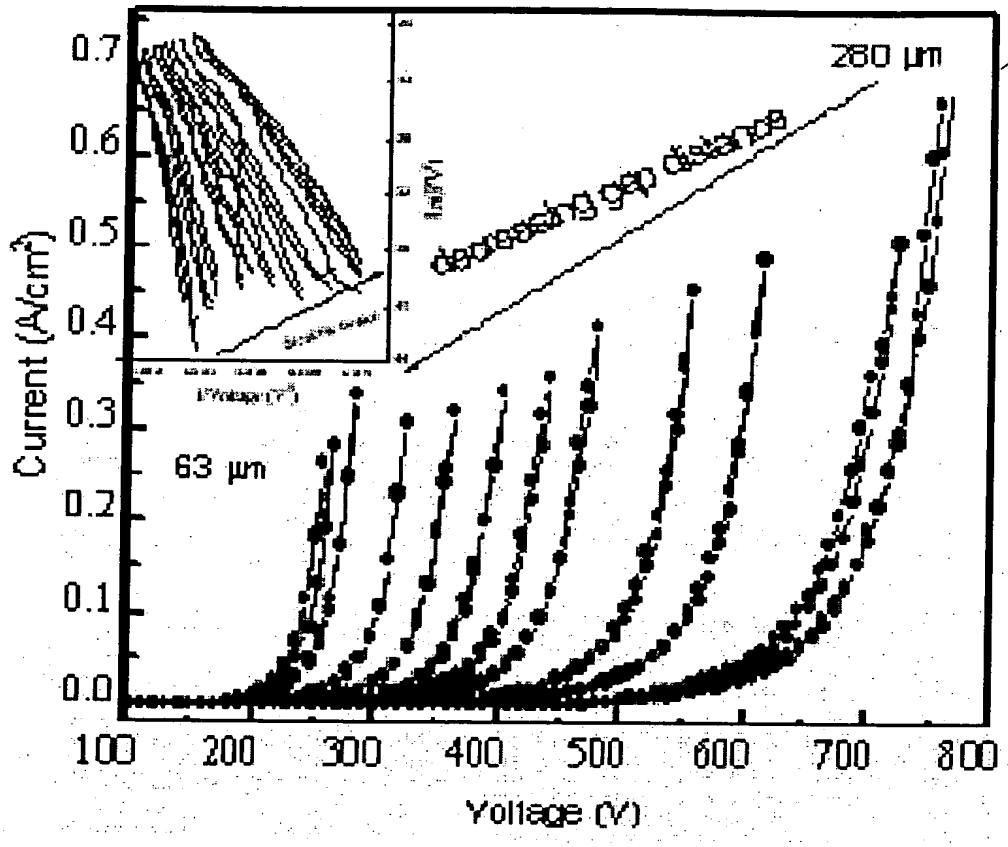
81
280 µm
decreasing gap distance
63 µm
Current (A/cm²)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
100
200
300
400
500
600
700
800
Voltage (V)

FIGURE 20

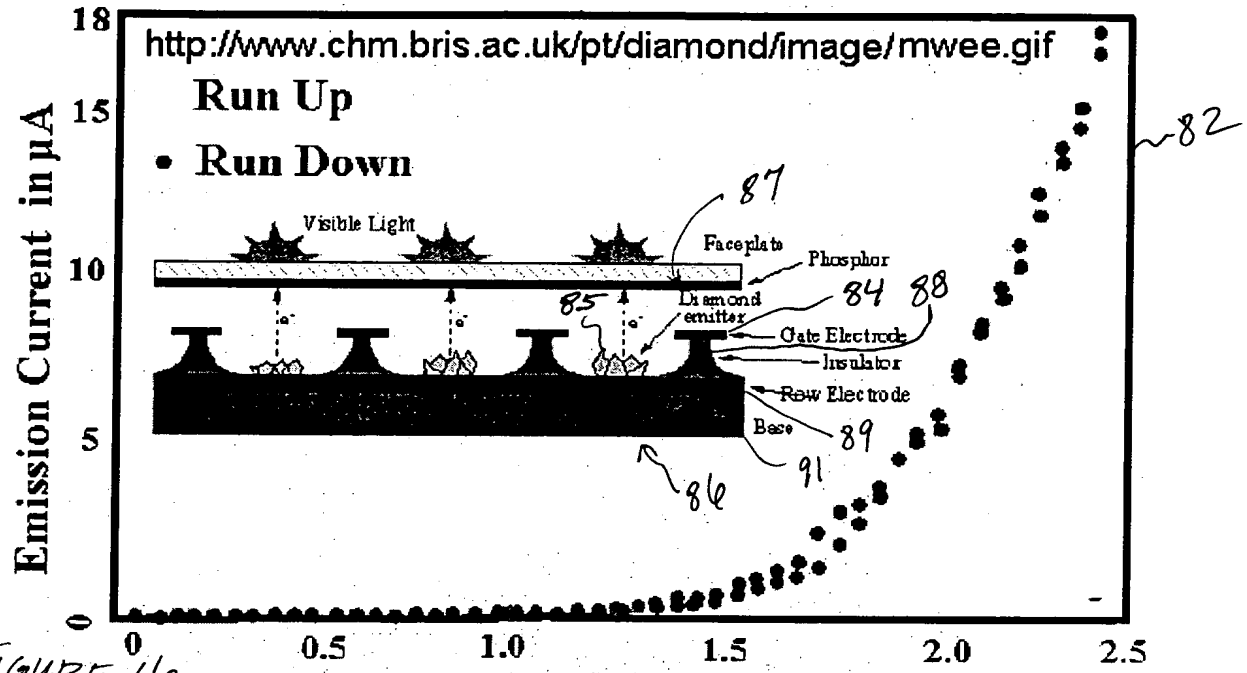

FIGURE 11a

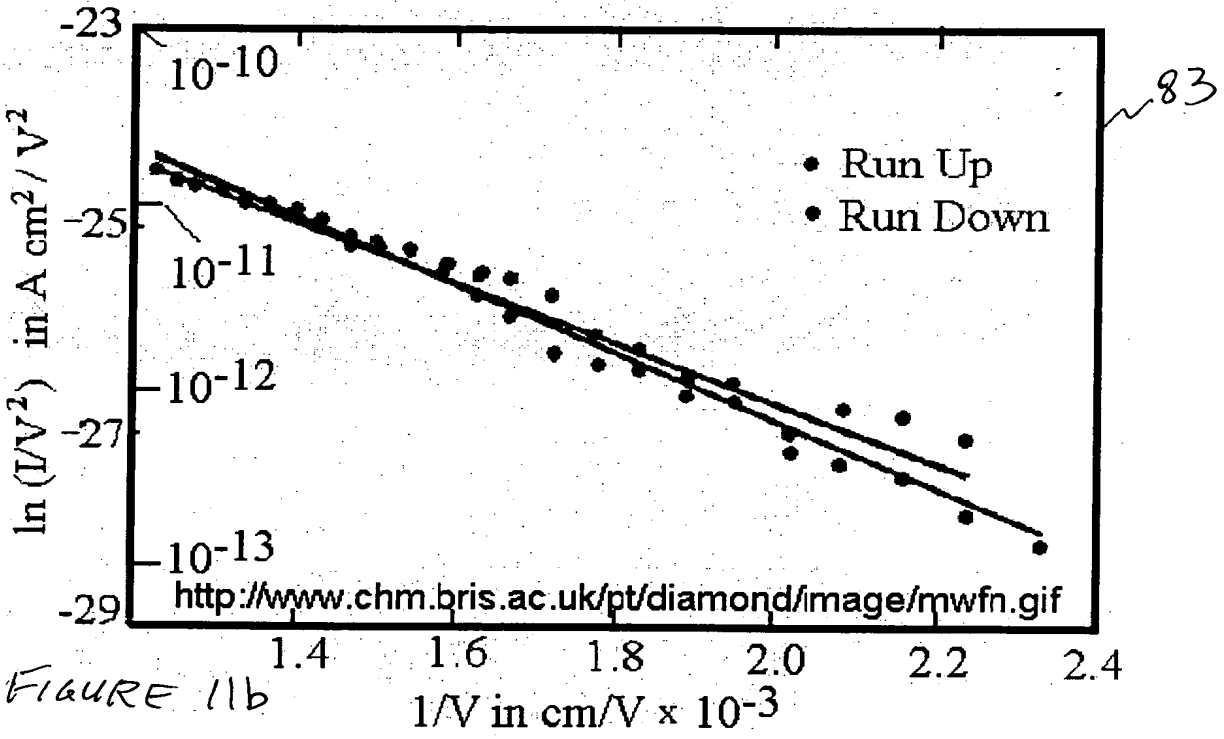

FIGURE 11b